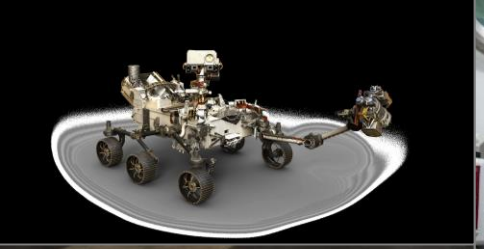





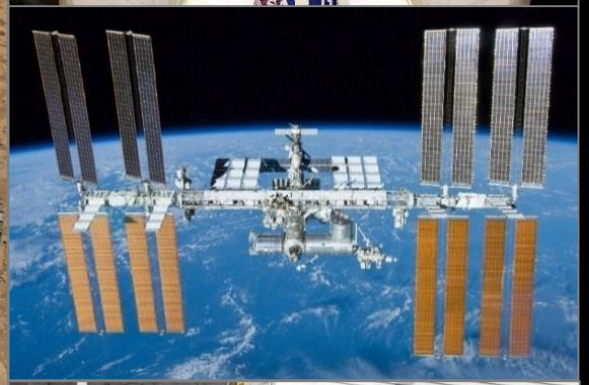


EXTRACTING VALUE FROM NASA QUALITY ENGINEERING AND ASSURANCE DATA

William Walker, Ph.D. [1,2]
william.walker@nasa.gov

Additional Contributors
Peter Checklick [1,3]
Jeannette Plante [1,4]

2019 NASA Quality Leadership Forum

March 13th - 14st, 2019
Cape Canaveral, Florida

[1]*National Aeronautics and Space Administration (NASA)*
[2]*Johnson Space Center (JSC)*
[3]*Kennedy Space Center (KSC)*
[4]*Office of Safety and Mission Assurance (OSMA)*

RECENT INSPECTOR GENERAL AUDIT ON NASA'S PARTS QUALITY CONTROL PROCESS

- **Audit findings from the NASA Office of Inspector General (IG) Office of Audits on "NASA's Parts Quality Control Process":**
  - Released March 29th, 2017
  - Report No. IG-17-016
- **Reason for performing the audit:**
  - NASA builds and operates launch vehicles, propulsion systems, robots, satellites, telescopes, and other complex science instruments
  - Using high performing and high quality parts is critical to mission success
  - However, IG reports that in the past 10 years NASA has incurred financial losses of approximately $1.3 billion from failures that occur due to parts not meeting expectations
  - Concerns also exist regarding NASA's increased usage of commercially produced "off-the-shelf" items and the risks this may pose to the Agency's parts quality control process
- **The IG audit on parts evaluated the following:**
  - Parts and supplier quality control processes
  - Parts and supplier data collection and sharing practices
  - Processes for overseeing contractor quality management systems
  - Various Agency policies and procedures
- **The IG auditors spoke with Agency, Government, and industry officials; also spoke with personnel from several major projects**


NASA
National Aeronautics and Space Administration

Office of Inspector General
Office of Audits

NASA'S PARTS QUALITY CONTROL PROCESS

March 29, 2017

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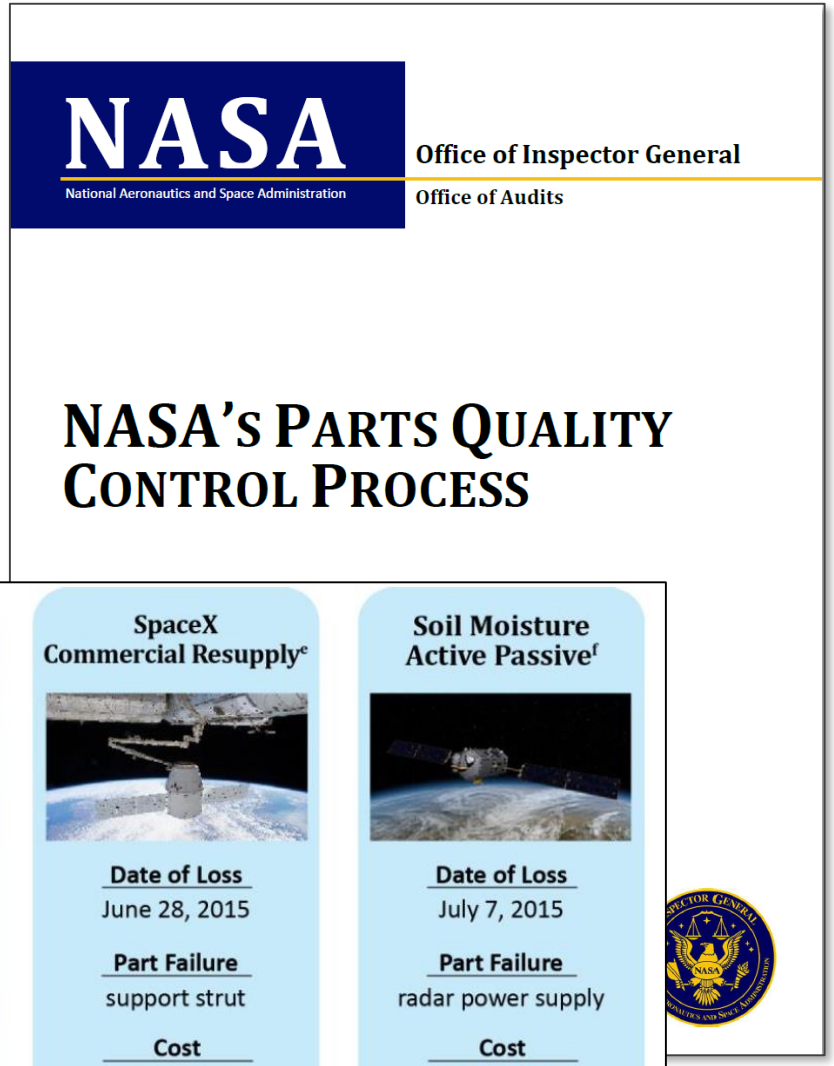

INSPECTOR GENERAL RECOMMENDATIONS

1. **Expand current NASA data sharing structure to integrate supplier databases with parts databases.**
2. **Investigate causes of gaps in SAS reporting and formulate remedial actions to ensure compliance with SAS reporting requirements.**
3. **Identify supplier performance information of common interest and modify SAS data structure to accommodate such information.**
4. **Collaborate with Office of the Chief Engineer to identify parts history information of common interest and modify EPARTS data structure to accommodate that information and to link to supplier information databases.**
5. **Examine the feasibility of further expanding NASA's parts and supplier data collection efforts to include contractor maintained data regarding parts and suppliers utilized in NASA contracts.**
6. **Evaluate current parts and supplier database system architectures to determine the cost and benefits of establishing an Agency-wide database system as opposed to maintaining current decentralized database systems.**
7. **Incorporate a feedback process to improve the Agency's tracking and recording of contractors' and suppliers' submissions of GIDEP alerts and Agency action notices.**
8. **Review a representative sample of PQASPs to identify deficiencies and best practices and revise policy as needed to include quantification and documentation of nonconformance and control risks for ensuring surveillance activities and resources are commensurate with part criticality and overall accepted project risk.**

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INSPECTOR GENERAL RECOMMENDATIONS

Recommendation 1: Expand current NASA data sharing structure to integrate supplier databases with parts databases.

Recommendation 4: Collaborate with Office of the Chief Engineer to identify parts history information of common interest and modify EPARTS data structure to accommodate that information and to link to supplier information databases.

Recommendation 6: Evaluate current parts and supplier database system architectures to determine the cost and benefits of establishing an Agency-wide database system as opposed to maintaining current decentralized database systems.

"Although NASA has a number of initiatives in place to help ensure the selection of quality parts from reliable suppliers, Centers generally manage their parts quality and supplier assessment data unilaterally rather than collaborating through a comprehensive, integrated, Agency-wide parts and supplier information system. Specifically, the Agency does not maintain a centralized parts quality history database or facilitate the integration of individual Center systems, track all relevant supplier performance history, or enforce requirements that Centers participate in Agency parts quality management systems."

RECOMMENDATION VERSUS REALITY

- **The IG recommendations from the Audit on NASA's Parts Quality Control Processes (recommendations 1, 4, & 6 in particular) are illustrative of what an outside entity like the IG would naturally assume regarding:**
  - NASA's access to basic supply chain and product quality data and,
  - NASA's readiness to analyze the data and use results to drive risk-based decisions
- **These are arguably relatively sensible assumptions considering the availability of modern data analysis tools**
- **However, these recommendations are in stark contrast to NASA's data security and (or) access realities:**
  - Oversight and restrictions… general NASA data protection and security, DCMA data protection and security, proprietary restrictions for commercial data, EAR/ITAR restrictions, et…; all of which would have to be satisfied by an Agency level work flow tool
  - The aforementioned brings to question the next point – deciding who gets access to the Agency level work flow tool? To the dashboards? To the analysis? To the trends information? To the raw data? How do you control and monitor users?
  - Most NASA maintained data is going to be stored on Center controlled servers; however, NASA Centers have complex firewalls and substantial server security that need to be passed before data can even be reached
  - Also, it would be important for the Agency level work flow tool to have real time access to the latest data (i.e. not a snapshot of the past)
  - The previous points cover "NASA Controlled" data, but what about the fact that ~80% of hardware is procured rather than developed in-house? In this case, part data is owned and controlled by an external supplier

OTHER OBSTACLES

- **Mission-driven organization makes big infrastructure projects programmatically challenging**
- **NASA Centers are great at solving their own problems – this includes quality control!**
  - However, that means that database designs exist that serve relatively limited purposes and users
- **Different types of data storage repositories:**
  - Databases, each formatted differently, and tracking different types of data
  - Workflow tools, each formatted differently, and tracking different types of data
  - SharePoint and Web-based tools, no telling what can be found here!
  - Excel-based repositories (e.g. the document I created to start tracking quality data found in OCE reports)
  - Hard copies (yes, I mean paper!)
- **There are few required closed loop processes that demand stockpiling and analyzing of quality data**
- **Getting Center-level buy-in; how do you convince and encourage Center level-users to utilize and populate an Agency level work flow tool without laying down new blanket requirements?**
- **Who manages the Agency Level Work Flow tool and how do you make sure it is up to date?**
- **Deciding what data to extract?**
  - Parts data, supplier data, non-compliance info, corrective actions info, et…
  - Too many “ideas” to list here…

HIGHLIGHT ON OSMA'S RESPONSE TO RECOMMENDATIONS 1 & 6

1. **Expand current NASA data sharing structure to integrate supplier databases with parts databases.**
   - OSMA's Response: Concur. The Chief, Safety and mission Assurance (SMA) will collaborate with Office of the Chief Engineer (OCE) and Center, program and project stakeholders to assess the feasibility and benefits of integrating supplier quality and parts databases currently maintained by the Office of Safety and Mission Assurance (OSMA), OCE, and NASA programs/Centers.

6. **Evaluate current parts and supplier database system architectures to determine the cost and benefits of establishing an Agency-wide database system as opposed to maintaining current decentralized database systems.**
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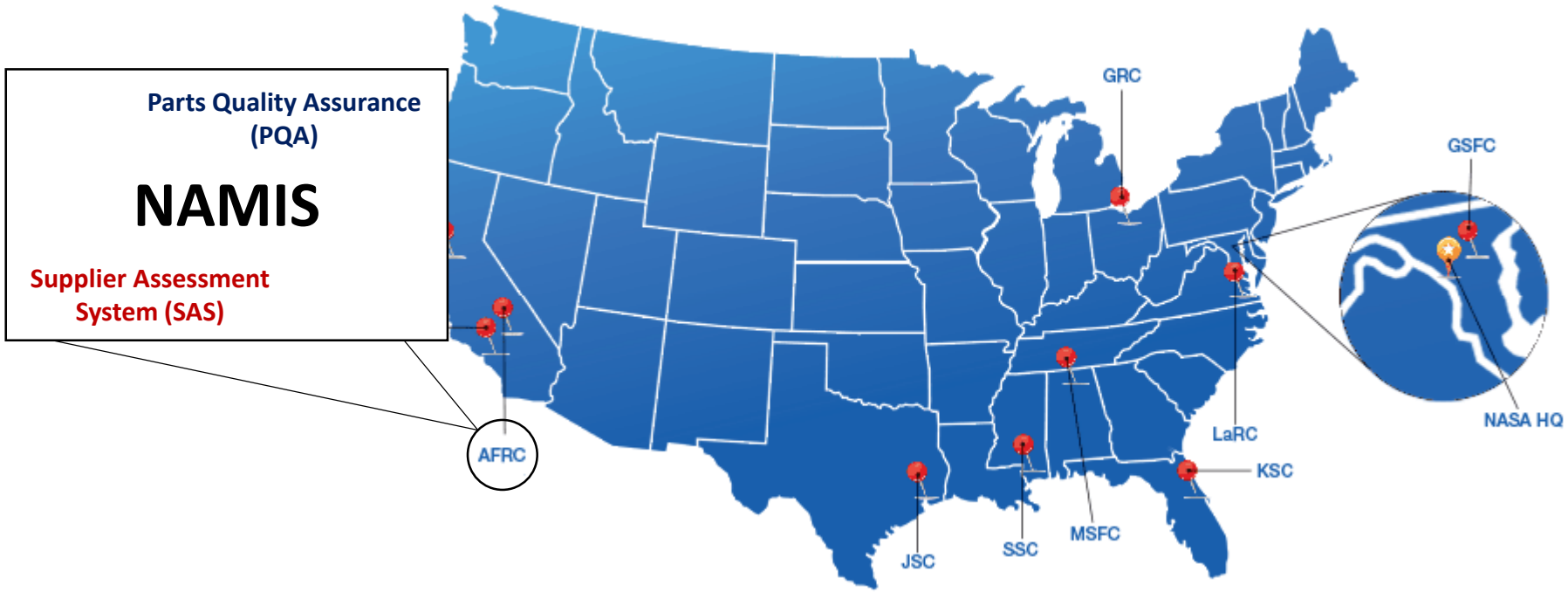
The purpose of my study derived from OSMA's agreement to assess better methods and techniques for integration of parts and supplier related quality engineering and assurance data. Here we seek to (1) identify data sources throughout the Agency, (2) understand what is being done with said data, (3) make recommendations on how NASA can integrate this data, (4) demonstrate what can be accomplished with an integrated workflow tool.

OUR APPROACH

- **STEP 1: PICK-UP THE PHONE**
  - Contacting all quality engineering and assurance experts throughout the agency
- **STEP 2: ASK THE EXPERTS**
  - What data is collected at your Center?
  - Where is the data stored? Excel? SharePoint? Database? Online? Et…?
  - What do you do with the data you collect?
  - Do you currently use historical data for trending analysis?
  - Is your main goal of data collection for closed loop reporting?
  - What obstacles exist to 3rd party access to your data repository?
- **STEP 3: DOCUMENT FINDINGS**
  - Counterpart Peter Checklick (KSC) and I have been recording every data source that we identify through these conversations in preparation for future integration activities
- **STEP 4: PREPARE FOR INTEGRATION**
  - 3rd party data extraction, integration, and analysis tools exist (e.g. Tableau)
  - Scheduled to take Tableau training in the near term to assess the feasibility of using this tool to meet Agency level integration needs
  - Identifying Center-level databases to use as pilot sources
- **STEP 5: DETERMINE FUNDING SOURCES AND PROCEED WITH PILOT PROGRAM**
  - Evaluating OSMA resources… Digital Transformation Resources…. Center Level Resources…

WHAT HAVE WE FOUND SO FAR?

- **Conducted in-depth interviews, often face-to-face, with quality engineering and assurance experts across the agency:**
  - Task was split between myself and counterpart Peter Checklick (KSC)
  - In general, we've discussed what's collected, where it's put, and what it's used for
  - Developing a comprehensive list of data storage repositories and Center level points-of-contact (POCs)
- **Interviews still remaining or in works include ARC, SSC, and MSFC (Checklick) and JPL, AFRC, LaRC (Walker)**



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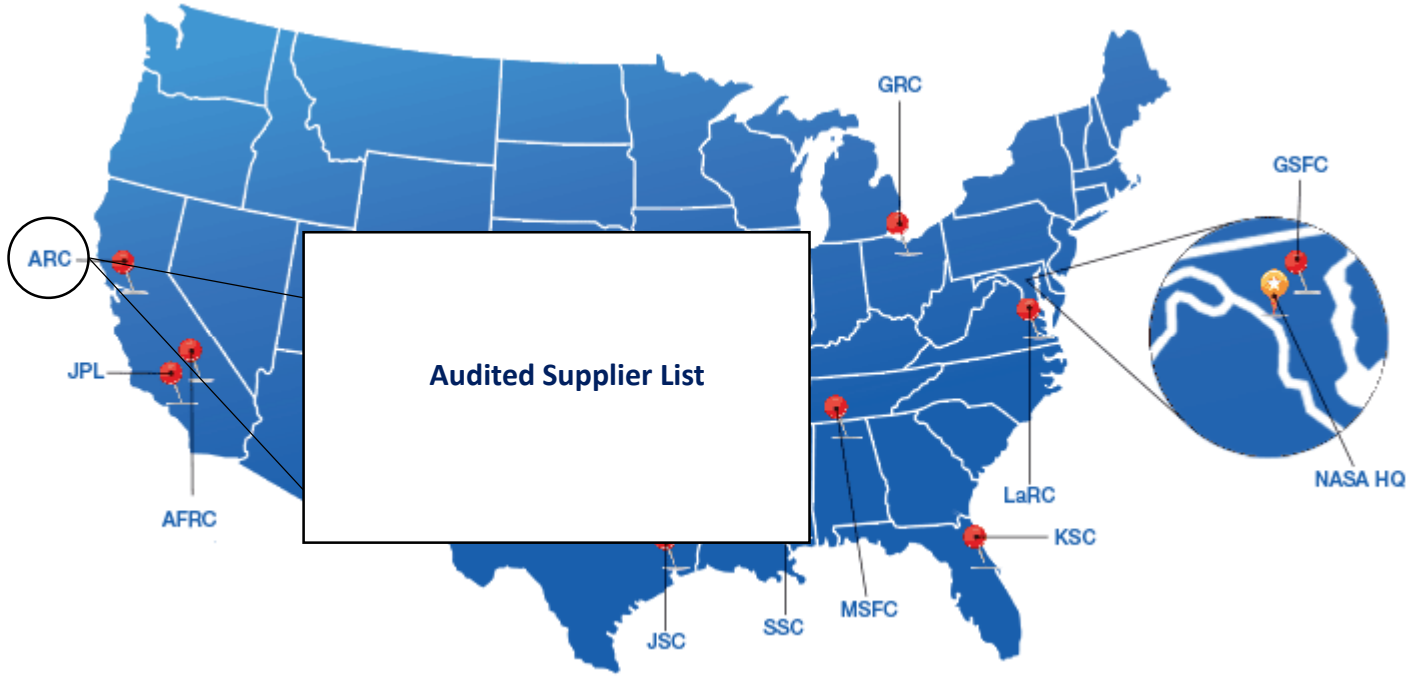

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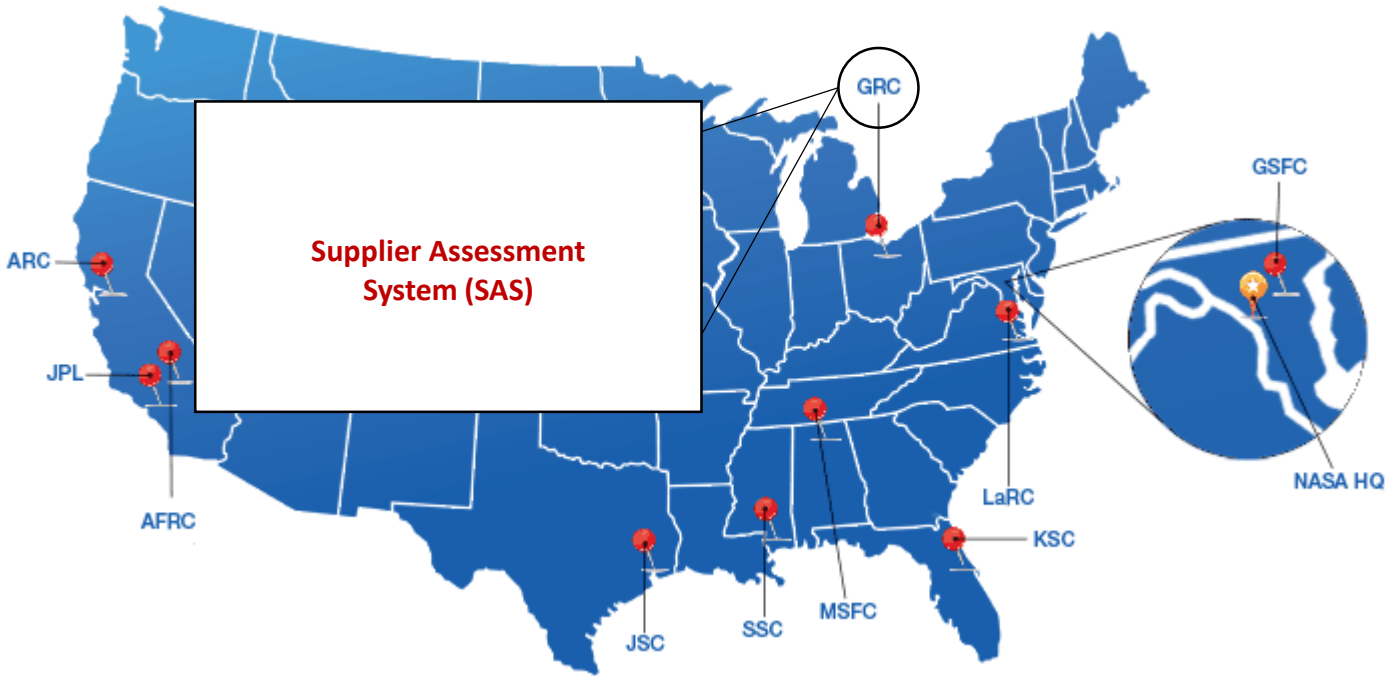

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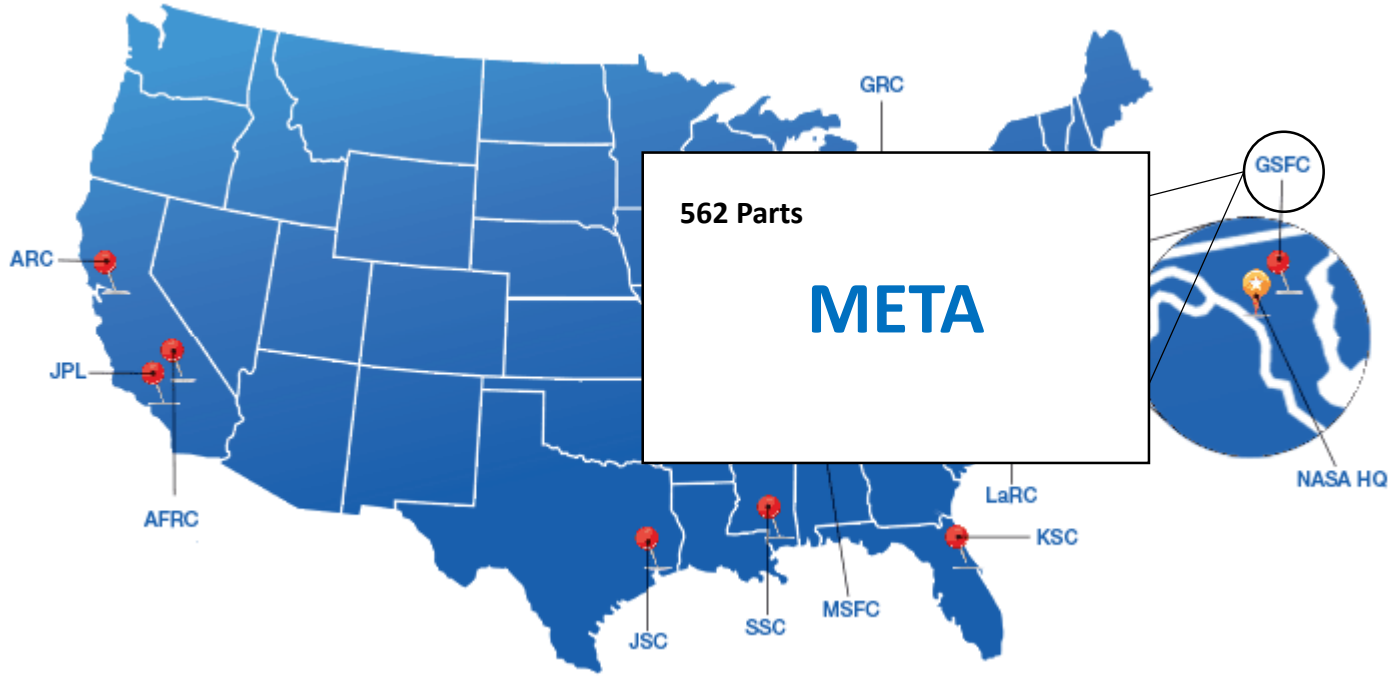

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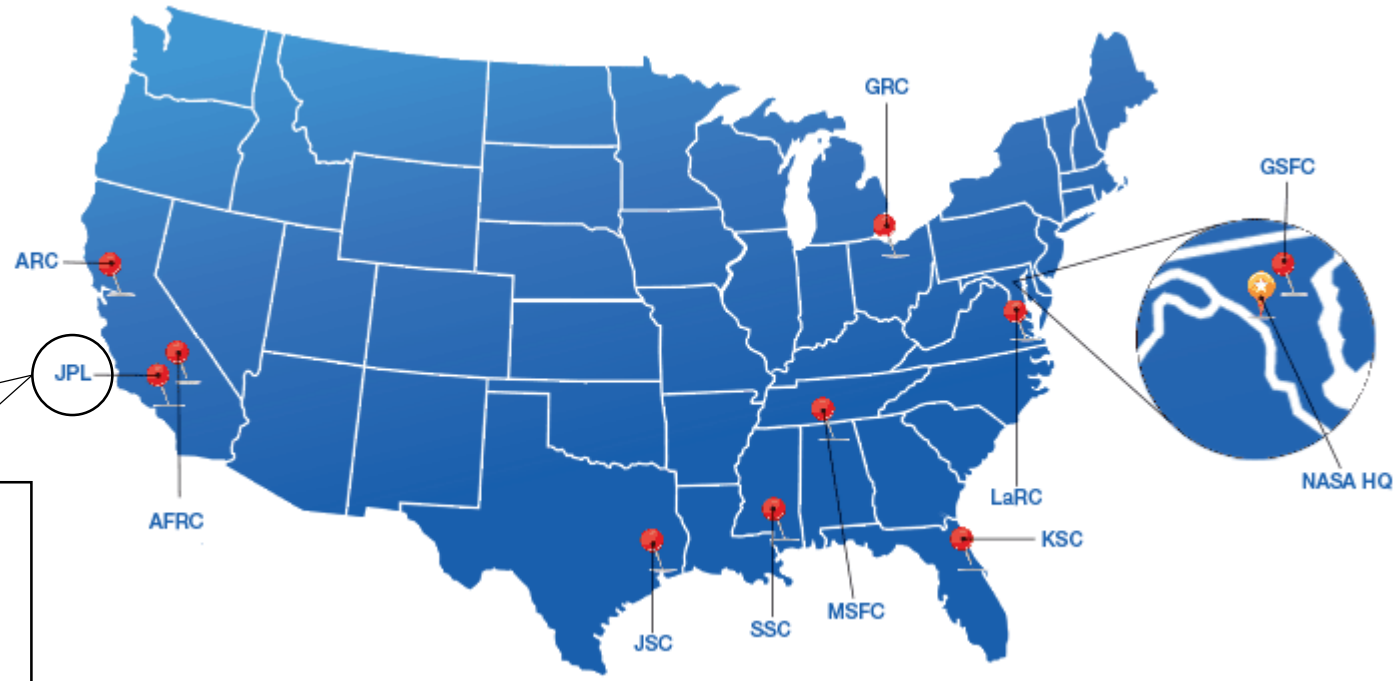

Approved Supplier List (ASL)

Property Accountability Reporting System (PARS)

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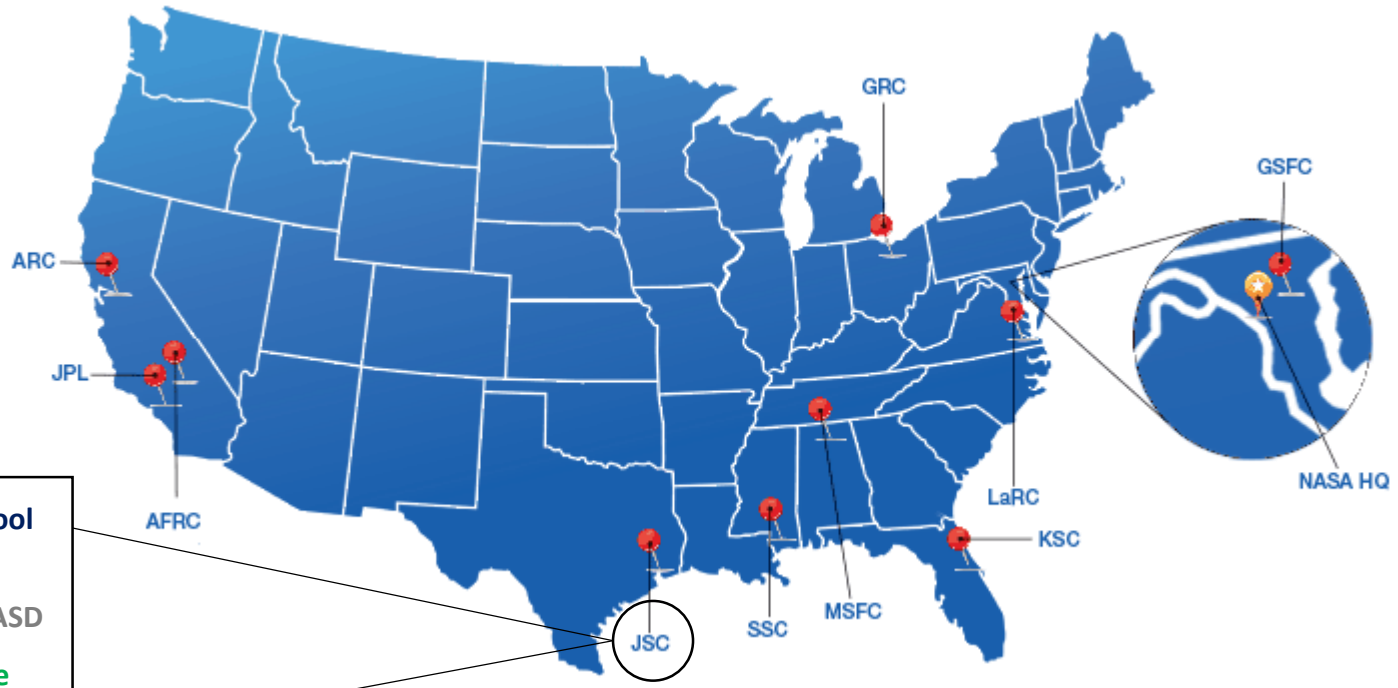

Problem Analysis Reporting Tool (PART)

Approved Supplier Database (ASD

QPID and QPID Website

Supplier Assessment System (SAS) **WASAP**

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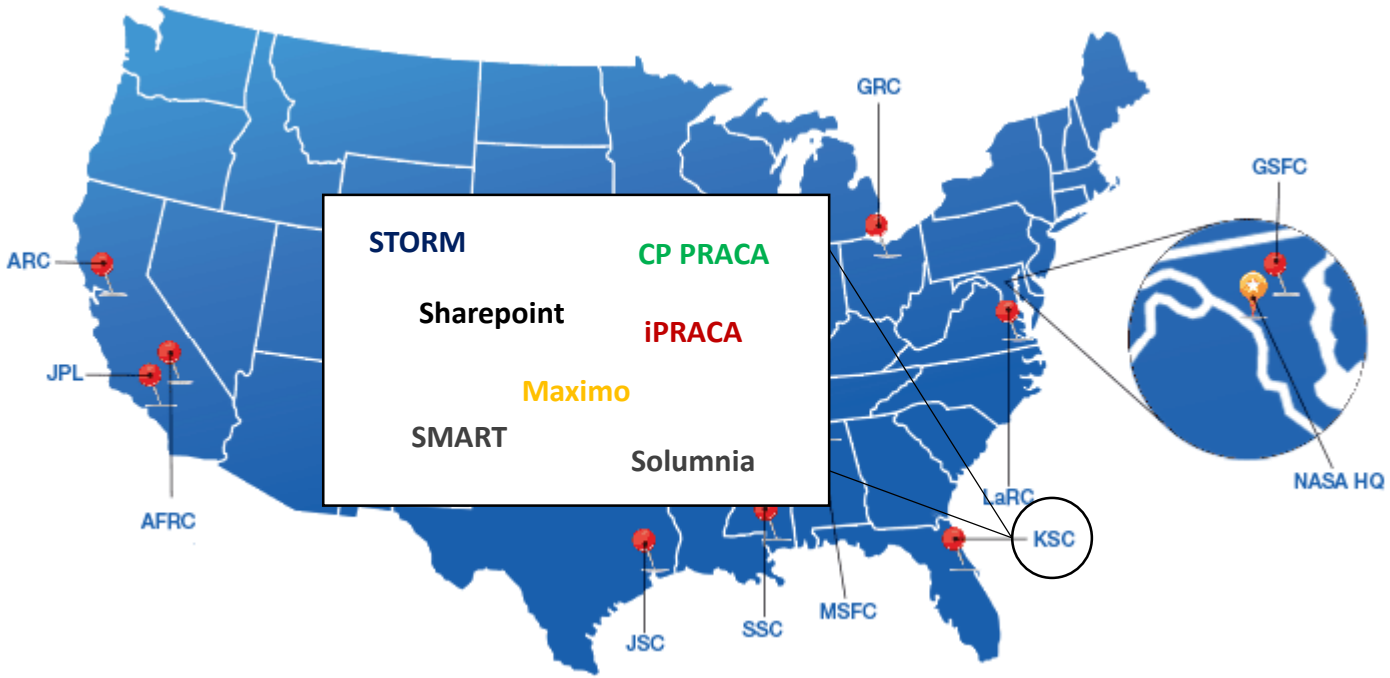

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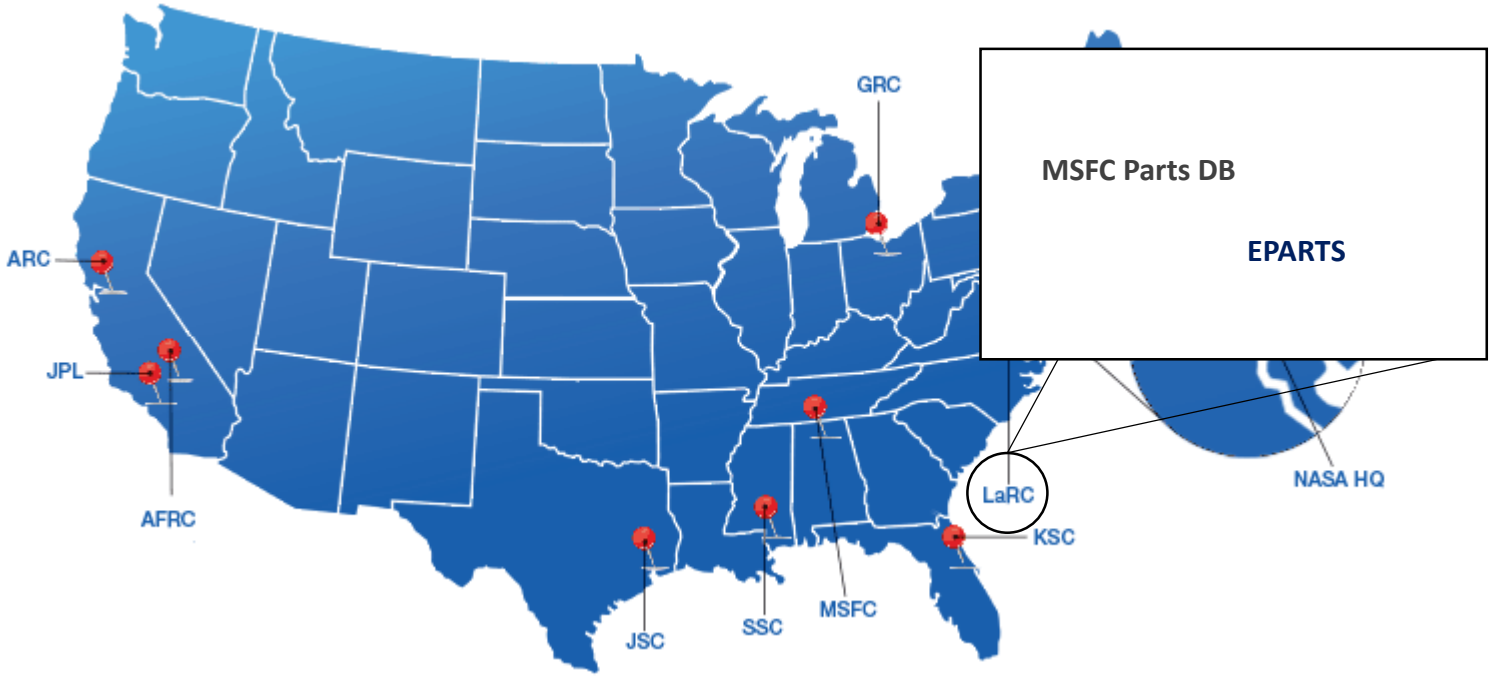

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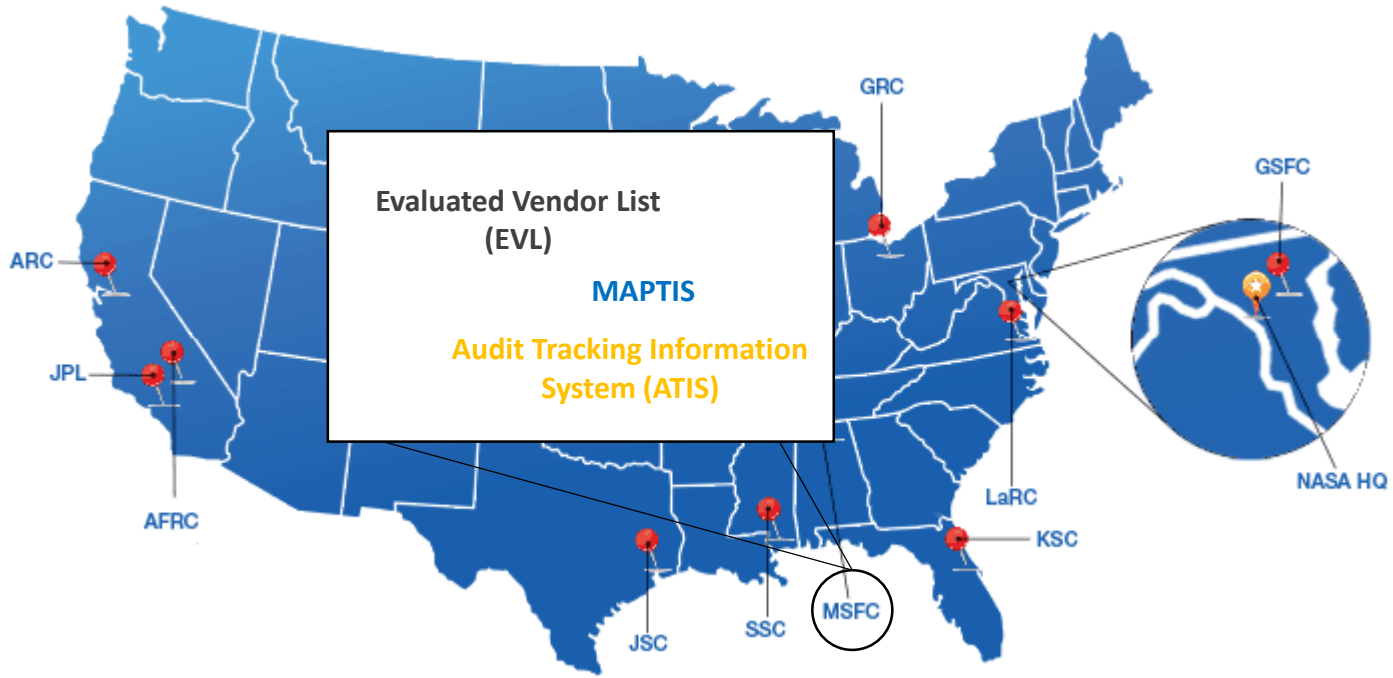

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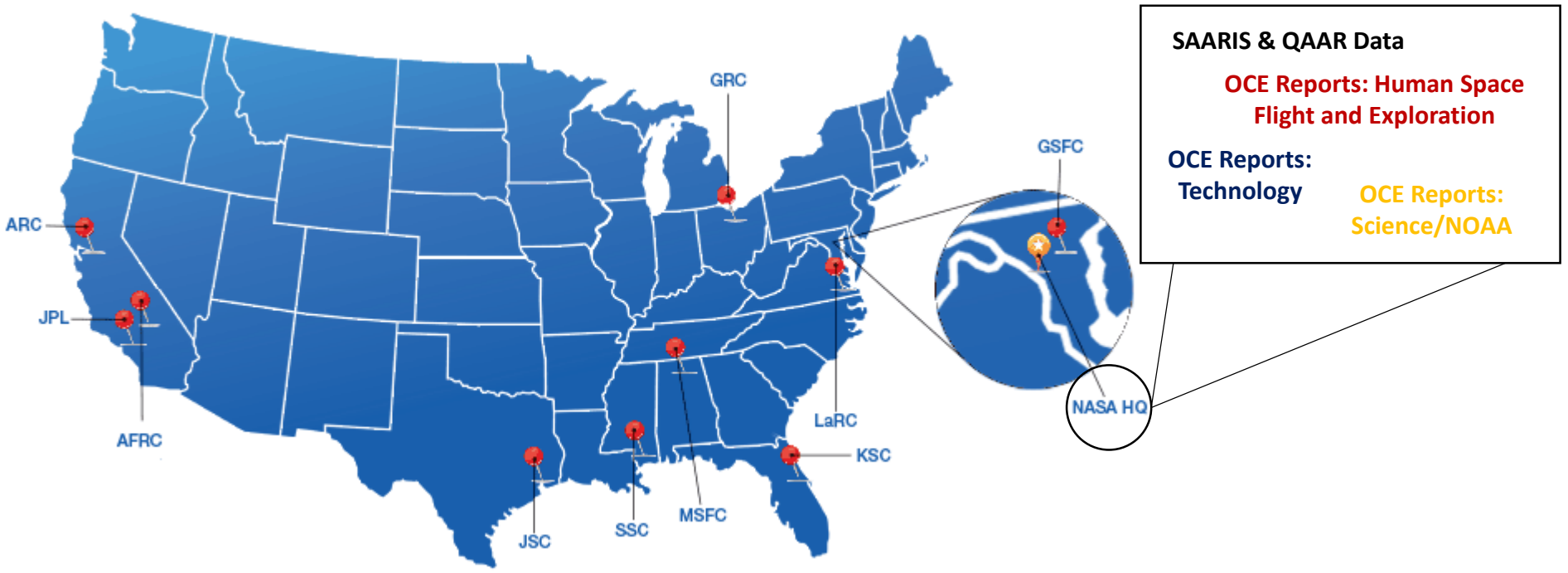

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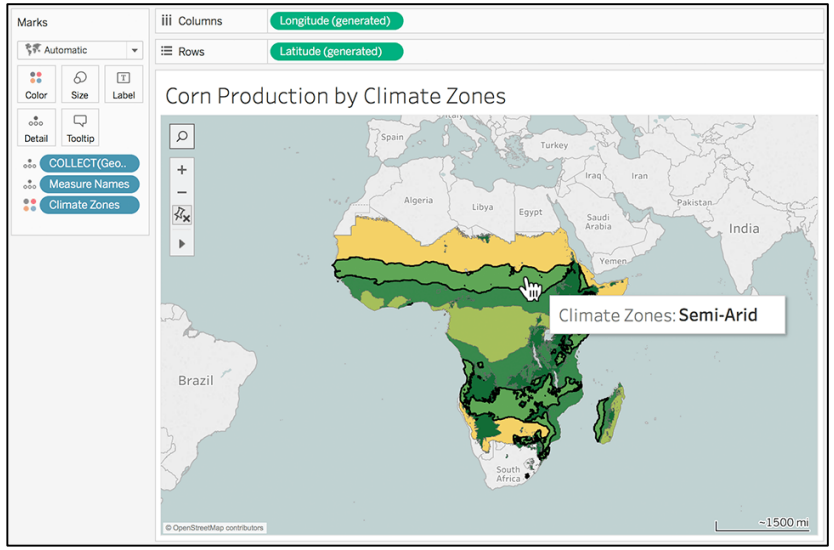
INPUTS FROM THE DEFENSE CONTRACT MANAGEMENT AGENCY (DMCA)

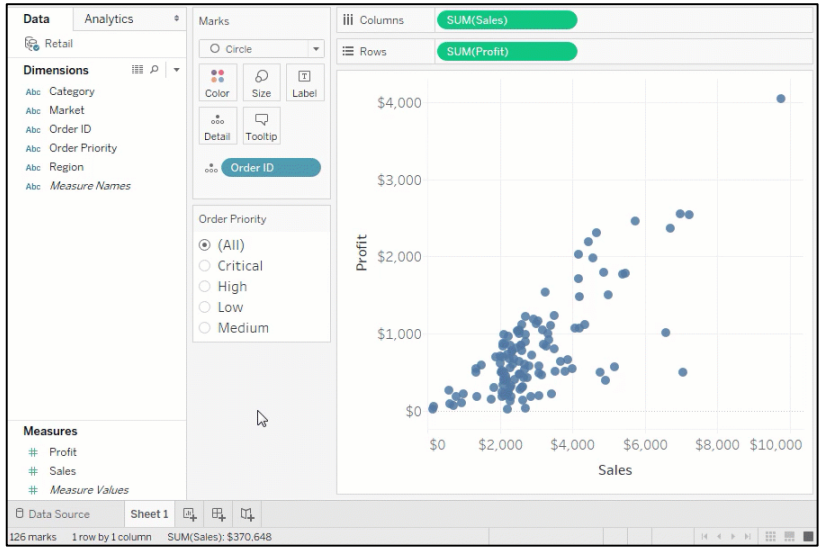
- **The Defense Contract Management Agency (DCMA) has a work agreement (MOU/LOD) to perform surveillance, conduct audits, and collect data for NASA for:**
  - Suppliers and vendors
  - Prime and Sub-contractors
  - Suppliers, vendors, and contractors are all tracked by CAGE codes
  - Data can also be tracked by Project Codes
- **DCMA tools and data repositories you may be familiar with:**
  - Supplier Risk System (SRS)
  - CAR/ECAR
- **Utilizing DCMA data has its own challenges:**
  - Although they collect data that is useful to NASA, DCMA is really structured to support Department of Defense needs and requirements
  - Access to data is highly controlled
  - Generating NEW forms and reports to get the data NASA need's in a format that is useful to us is not as straight forward as you might think; in general, I've found that the data we need is there, but DCMA is not readily able to report the data in a way that supports data analysis and trending
- **How do we improve NASA's ability to access and utilize DCMA data?**

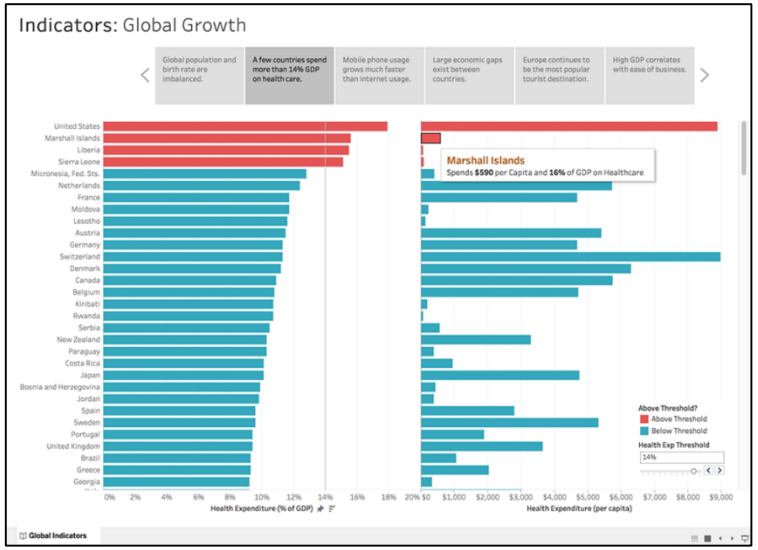
SHARING PLATFORM: TABLEAU

- **The overall focus is extraction of value from quality engineering and assurance data:**
  - With data sources and POCs identified, how do you go about extracting data?
  - Aside from previously mentioned obstacles to an agency level workflow tool, we could potentially implement this via a sharing platform
  - Multiple tools exist (e.g. ClickShare and Tableau)

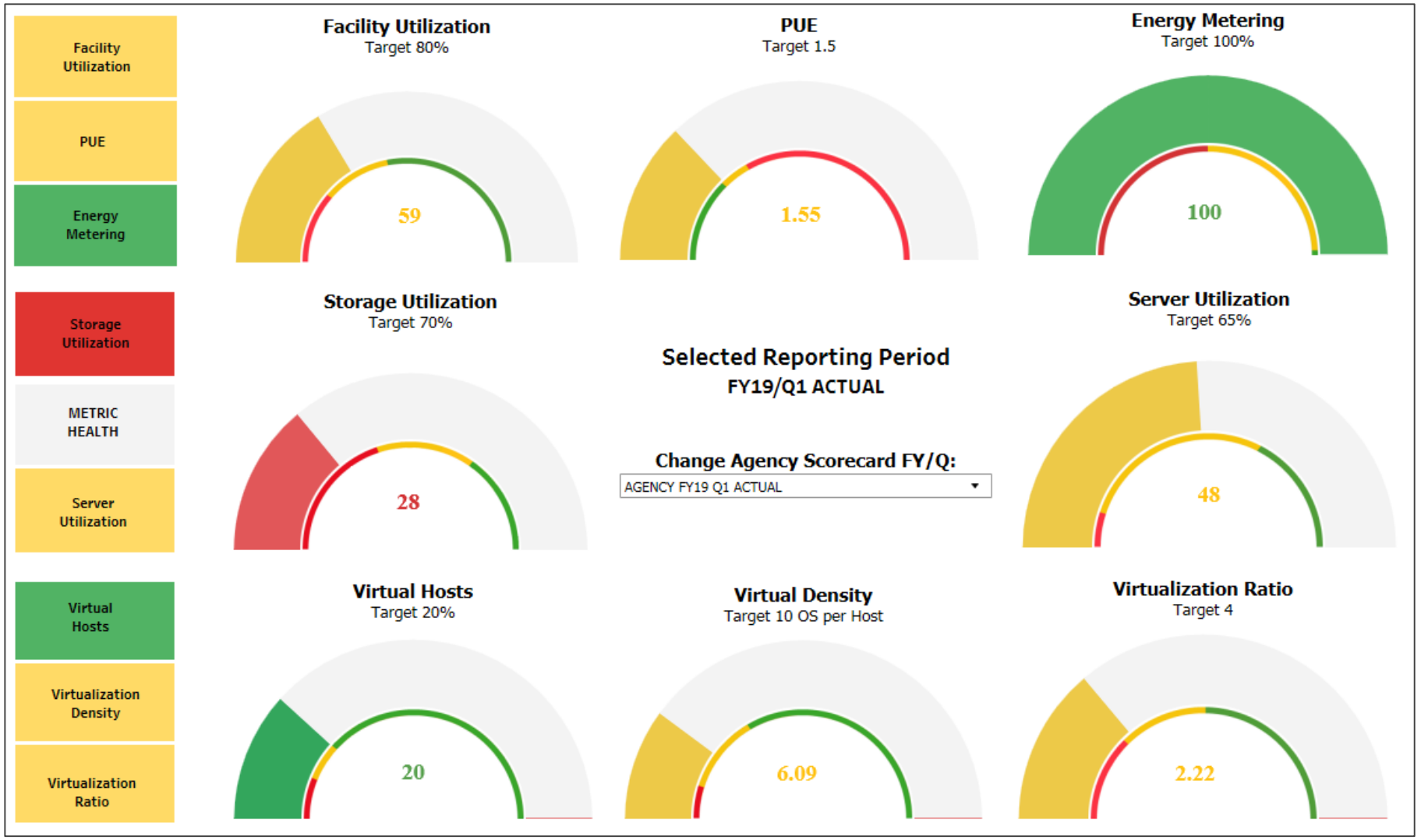
- **Tools like ClickShare and Tableau (currently leaning this direction) are designed to extract data, of any kind, from lots of data repositories and to help you do the following:**
  - Organize the data
  - Observe and analyze the data and trends
  - Present the data and trends
  - Always use the latest data as a function of all agency level inputs



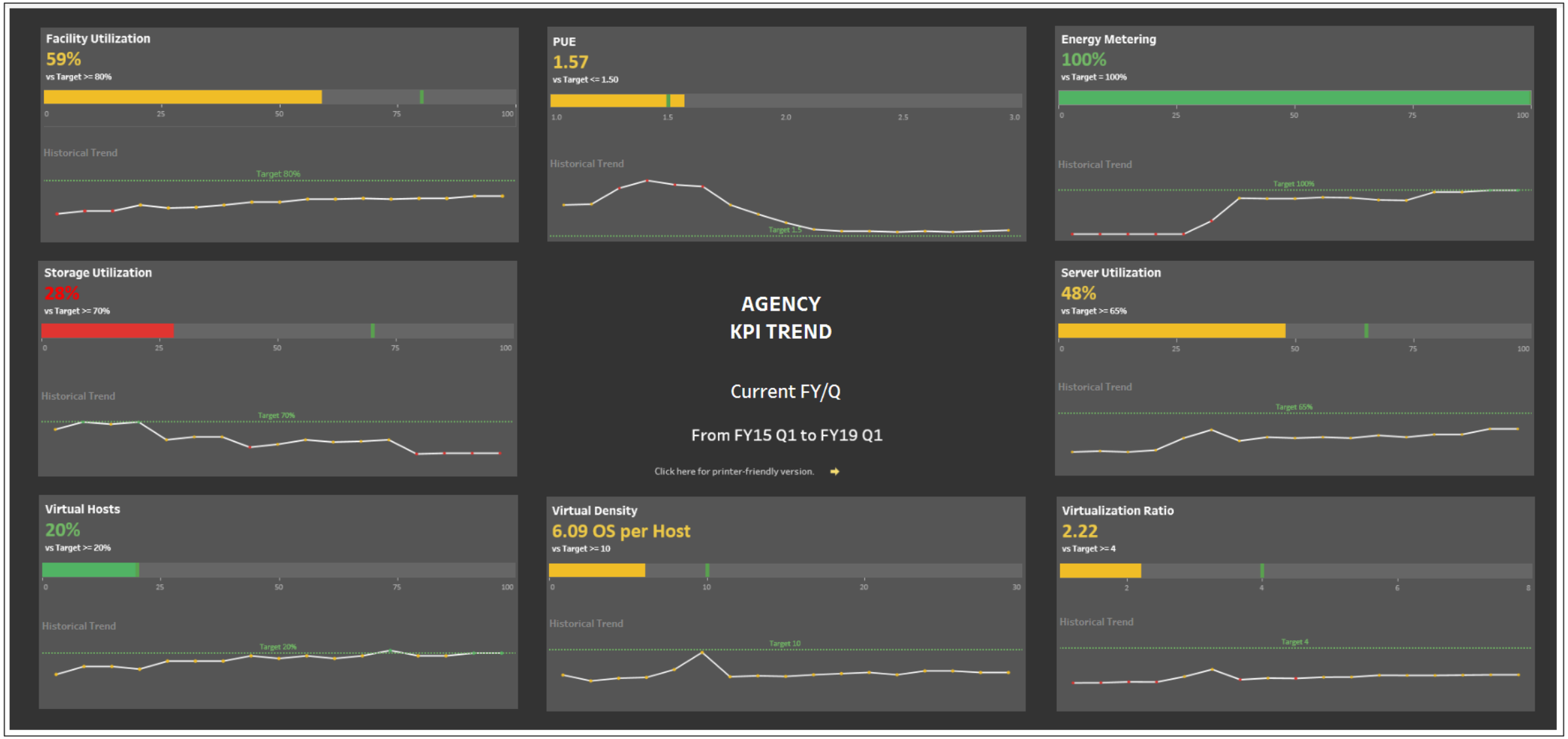




ADCC PMO TEAM DEVELOPED TABLEAU DASHBOARDS: AGENCY OMB SCORECARD



ADCC PMO TEAM DEVELOPED TABLEAU DASHBOARDS: AGENCY KPI TREND



ADCC PMO TEAM DEVELOPED TABLEAU DASHBOARDS: DATA CENTER CLOSURE DASHBOARD

Data Center Closure Status Dashboard

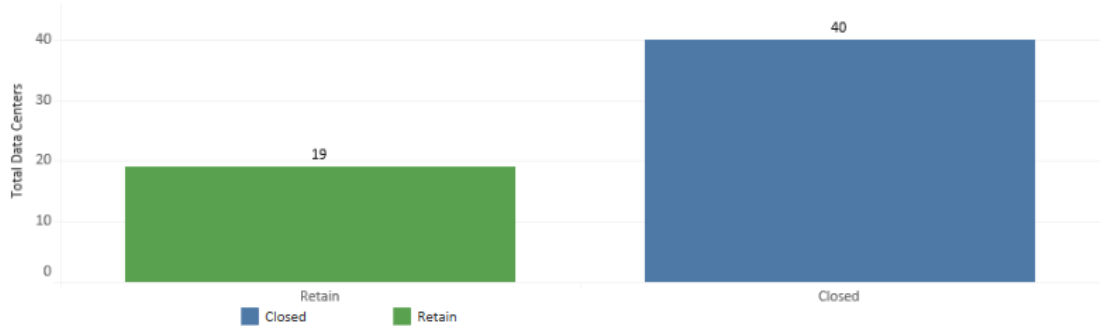
Based on DCOI Quarterly Data Collection and Reporting

Quarterly Summary Report - FY18 Q4

Total DC Closures Prior to FDCCI Reporting	20
Total NASA Tiered Data Centers to Remain Open***	19
Total NASA DC Closures Reported to OMB thru FY18 Q3	40
Total Closures for FY18 Q3	0
Planned Closures Remaining for FY18	0
Planned Closures for FY19	0
Planned Closures for FY20	0
Total Square Footage Disposed/Repurposed Reported	55,956
Total Servers Decommissioned Reported	312
Total Servers Moved to Other DC Reported	2,554

*** SSC and NSSC Combined into NCCIPS

Data Center Closure Status Totals



Data Center Clousres By Fiscal Year

Data Center Details

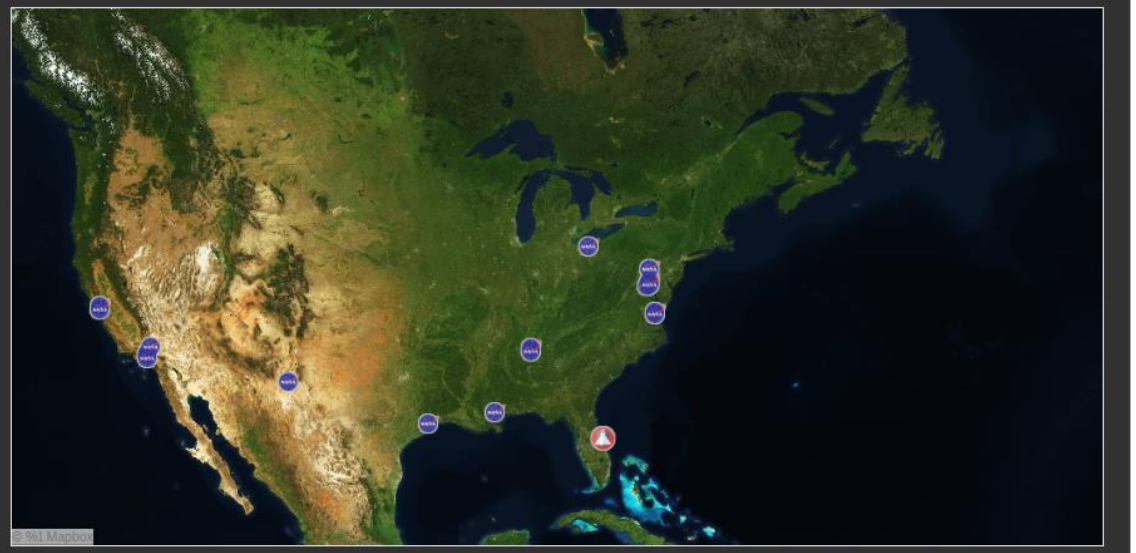
Data Center	Data Center Name	Closing Stage	Date Closed
AFRCDC1	Consolidated IT Center (CITC)	Retain	
AFRCDC2	Flight Loads Laboratory (FLL)	Closed	Q1/2011
AFRCDC4	Western Aeronautical Test Range (WATR)	Closed	Q2/2012
AFRCDC5	Dryden Aircraft Operations Facility (**Unplanned Closure)	Closed	Q2/2016
AFRCDC6	Research Aircraft Integration Facility (RAIF)	Closed	Q3/2013
ARCDC1	Central Computing Facility A	Retain	
ARCDC2	Central Computing Facility B	Closed	Q3/2011
ARCDC3	Central Computing Facility C	Closed	Q3/2010
ARCDC5	High End Computing	Retain	
GRCDC1	Engineering Design Server Room	Closed	Q4/2015
GRCDC5	IDAC Server Room	Closed	Q4/2010

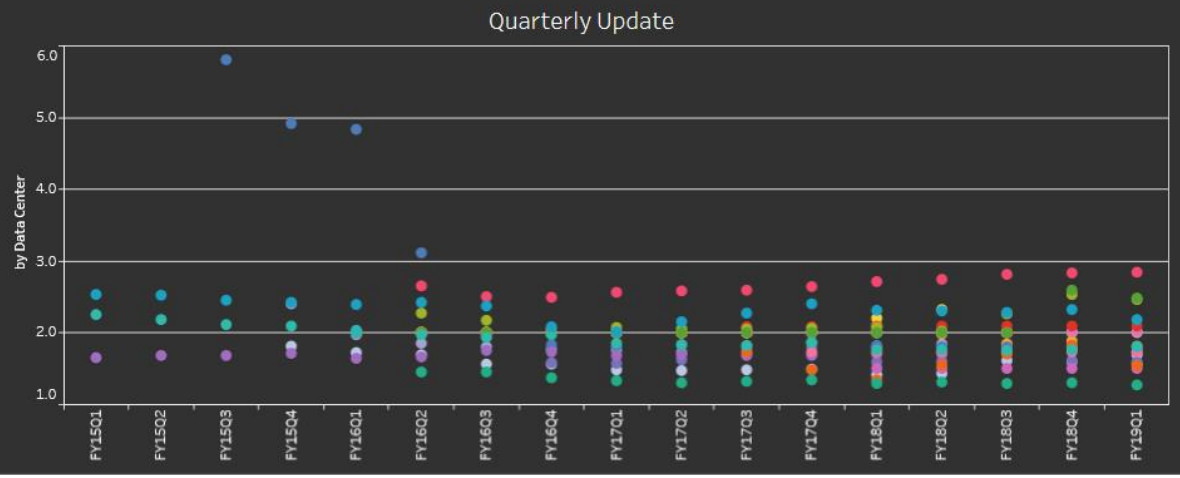
ADCC PMO TEAM DEVELOPED TABLEAU DASHBOARDS: OMB PUE UPDATE SUMMARY

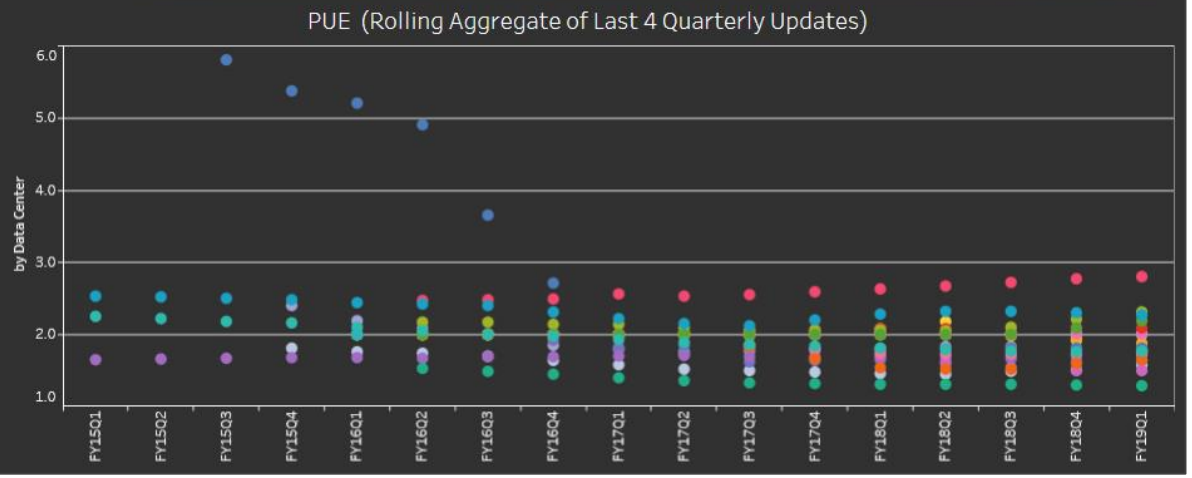
FY19Q1 PUE Update Summary

Link to update sheets on mouse-over

Data Center Name	DC Description	Legend	FY PUE	Total DC Lo..	Total IT Load	Annual PUE	Change
AFRCDC1	Consolidated IT Center (CITC)		2.18	177	81	2.27	-0.03
ARCDC1	Central Computing Facility A		1.80	355	197	1.77	0.01
ARCDC5	High End Computing		1.27	6,693	5,251	1.29	-0.01
GRCDC6	Research Analysis Center (RAC)		2.48	156	63	2.19	0.10
GSFCDC1	Code 700 Data Center		2.46	105	43	2.31	0.10
GSFCDC10	Building 32 Data Center (CODE 400)		2.09	1,595	763	2.09	0.00
GSFCDC6	CISTO/NCCS		1.54	2,508	1,631	1.65	0.05
HQDC1	NASA Headquarters Computer Center		2.84	145	51	2.80	0.03
JPLDC1	JPL 600-131		1.73	954	552	1.73	0.00
JPLDC2	JPL 171-399		2.01	21	10	2.01	0.00
JPLDC4	JPL 230-3rd Floor		1.50	272	181	1.50	0.00
JSCDC1	Base Operations Data Center		1.74	640	367	1.73	0.01
JSCDC18	White Sands Data Center (WSTF)		1.59	59	37	1.64	0.00
KSCDC1	KSC Data Center		1.80	321	179	1.81	0.00
LARCDC1	LDC Science Data Center / LDC Atmospheric Science Data Center		1.81	542	300	1.88	-0.07
LARCDC3	LDC OCIO Data Center/ Katherine G. Johnson Computational Research Facility		1.56	763	489	1.77	-0.15
MSFCDC2	Central Communication Facility		2.00	135	67	2.00	0.00
MSFCDC3	4663 - NDC(Wing B) / HOSC(Wing A)		1.72	517	300	1.79	-0.02
NCCIPSDC1	National Center for Critical Information Processing and Storage (NASA Tenants Only)		1.69	131	77	1.58	0.07
~ FY19Q1 Combined	Combined Quarterly update for all data centers Agency-wide		1.51	16,086	10,639		
~~Annual Combined	Combined PUE for all data centers Agency-wide			16,120	10,362	1.55	1.56



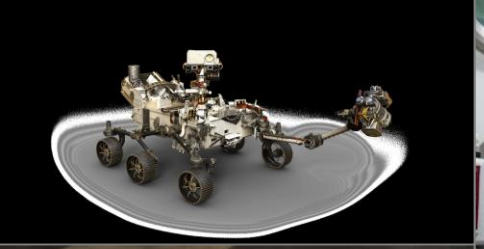




SUMMARY AND FUTURE ACTIVITIES

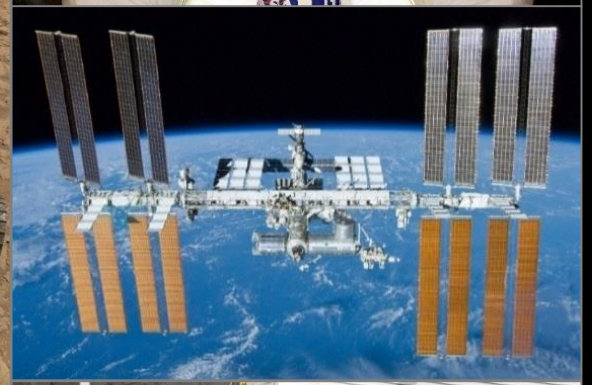
- **In response to recommendations from the Inspector General Audit on NASA's Parts Quality Control Processes, we are assessing better methods and techniques for integration of parts and supplier related quality engineering and assurance data. To accomplish the this we seek to:**
  - Identify data sources throughout the Agency
  - Understand what is being done with the data
  - Make recommendations on how NASA can integrate the data
  - Demonstrate what can be accomplished with an integrated workflow tool
- **Assessing the feasibility of implementing Tableau to meet these needs:**
  - Participating in a 3 day training next week
  - Collaborating with KSC IT experts who have already begun evaluation of the software
  - Identifying ideal NASA quality data repository candidates to use in pilot study
- **Working to improve NASA benefit from DCMA data:**
  - Continue dialog with DCMA counterparts to better understand the current status-quo of the NASA/DCMA relationship
  - Gaining access to DCMA tools (SRS, CAR, et…) to document what can and can't be accomplished by a NASA individual with log-in credentials
  - Evaluating current report templates that are available
  - Discussing what should be included in a future report template that is designed to reflect NASA's needs

Bottom Line: The quality engineering and assurance data is there, we "simply" need to develop methods that maximize the overall value that we can extract.

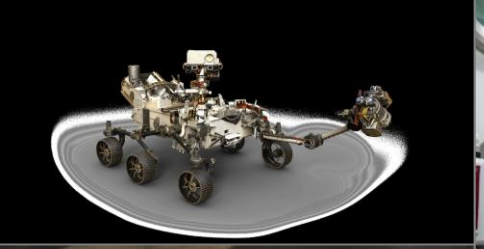




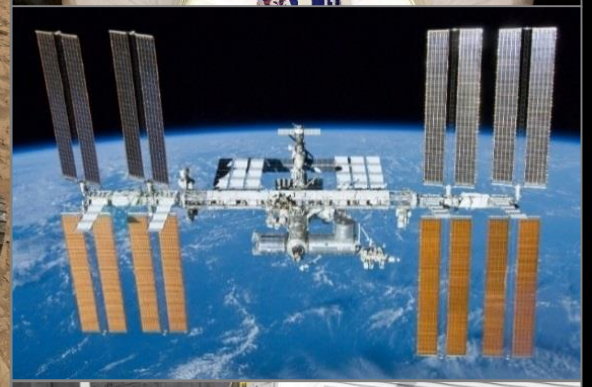





QUESTIONS?





BACK-UP

INSPECTOR GENERAL RECOMMENDATIONS

1. **Expand current NASA data sharing structure to integrate supplier databases with parts databases.**
2. Investigate causes of gaps in SAS reporting and formulate remedial actions to ensure compliance with SAS reporting requirements.
3. Identify supplier performance information of common interest and modify SAS data structure to accommodate such information.
4. Col… …ta str…
5. Exa… …ed data reg…
6. Evaluate current parts and supplier database system architectures to determine the cost and benefits of establishing an Agency-wide database system as opposed to maintaining current decentralized database systems.
7. Incorporate a feedback process to improve the Agency's tracking and recording of contractors' and suppliers' submissions of GIDEP alerts and Agency action notices.
8. Review a representative sample of PQASPs to identify deficiencies and best practices and revise policy as needed to include quantification and documentation of nonconformance and control risks for ensuring surveillance activities and resources are commensurate with part criticality and overall accepted project risk.

OSMA's Response: Concur. The Chief, Safety and mission Assurance (SMA) will collaborate with Office of the Chief Engineer (OCE) and Center, program and project stakeholders to assess the feasibility and benefits of integrating supplier quality and parts databases currently maintained by the Office of Safety and Mission Assurance (OSMA), OCE, and NASA programs/Centers.

INSPECTOR GENERAL RECOMMENDATIONS

1. Expand current NASA data sharing structure to integrate supplier databases with parts databases.
2. Investigate causes of gaps in SAS reporting and formulate remedial actions to ensure compliance with SAS reporting requirements.
3. Identify supplier performance information of common interest and modify SAS data structure to accommodate such information.
4. **Collaborate with Office of the Chief Engineer to identify parts history information of common interest and modify EPARTS data structure to accommodate that information and to link to supplier information databases.**
5. Examine the feasibility of further expanding NASA's parts and supplier data collection efforts to include contractor maintained data regarding parts and suppliers utilized in NASA contracts.
6. Evaluate curr… gency-wide databas…
7. Incorporate a… of GIDEP alerts and Agency action notices.
8. Review a representative sample of PQASPs to identify deficiencies and best practices and revise policy as needed to include quantification and documentation of nonconformance and control risks for ensuring surveillance activities and resources are commensurate with part criticality and overall accepted project risk.

OSMA's Response: Concur. The Chief, Safety and Mission Assurance, in collaboration with the OCE, will evaluate the benefits and feasibility of potential modifications of EPARTS to accommodate parts history information and links to supplier databases.

INSPECTOR GENERAL RECOMMENDATIONS

1. Expand current NASA data sharing structure to integrate supplier databases with parts databases.
2. Investigate causes of gaps in SAS reporting and formulate remedial actions to ensure compliance with SAS reporting requirements.
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5. Examine the feasibility of further expanding NASA's parts and supplier data collection efforts to include contractor maintained data regarding parts and suppliers utilized in NASA contracts.

OSMA's Response: Concur. The Chief, Safety and mission Assurance (SMA) in collaboration with Office of the Chief Information Officer (OCIO), Centers, and Program Offices, will evaluate the benefits and costs for establishing an Agency-wide system architecture that can accommodate cross-Agency quality parts data.

6. **Evaluate current parts and supplier database system architectures to determine the cost and benefits of establishing an Agency-wide database system as opposed to maintaining current decentralized database systems.**
7. Incorporate a feedback process to improve the Agency's tracking and recording of contractors' and suppliers' submissions of GIDEP alerts and Agency action notices.
8. Review a representative sample of PQASPs to identify deficiencies and best practices and revise policy as needed to include quantification and documentation of nonconformance and control risks for ensuring surveillance activities and resources are commensurate with part criticality and overall accepted project risk.